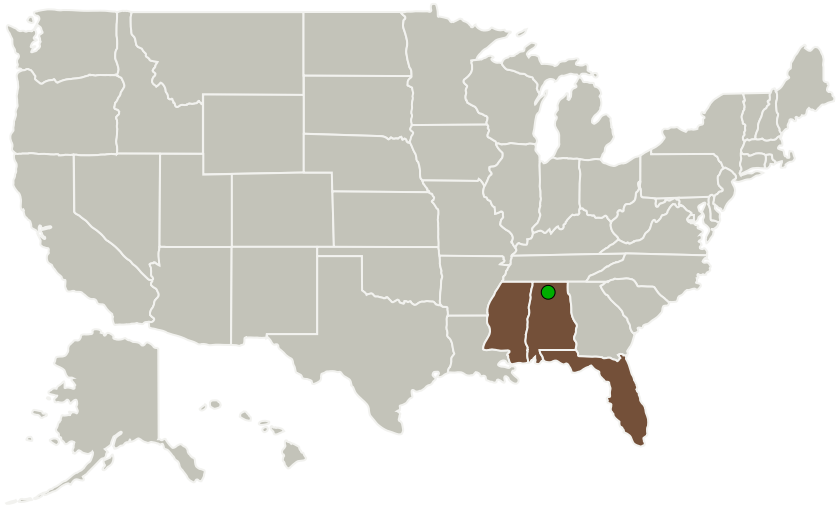
Colosed-Loop Control of the Thermal Stir Welding Process to Enable Rapid Process/Ppart Qualification, Phase I

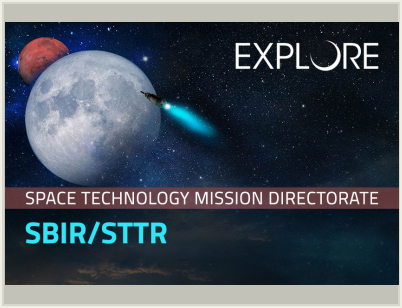
Completed Technology Project (2012 - 2013)

Project Introduction

Thermal Stir Welding (TSW) provides advancement over the more conventional Friction Stir Welding (C-FSW) process because it separates the primary processes variables thereby allowing independent control of metal stirring and forging from the stir zone temperature. However, the feedback for precise control of the stir zone temperature, and hence the process parameters to sustain that temperature within a narrow range, does not currently exist on the TSW machine at the NASA Marshall Space Flight Center (MSFC). At present, the current state of the art for the selection of process parameters for both TSWing and C-FSWing parameters is highly empirical and by nature is based on phenomenological knowledge. In response to this need, Keystone is proposing this Phase I SBIR project to demonstrate the feasibility of closed-loop control of the TSW process and to enable the establishment of a theoretically derived processing map to accelerate process understanding and selection of parameters for a given material and pin tool design. The close-loop control system will enable sustainment of a steady-state temperature at the stir rod as a function of spindle RPM and the travel velocity for a given z-axis loading and stir rod design. Use of this theoretically derived processing map will provide guidance in the optimization of the process parameter domain for solid-state welding of a given material. This capability will in turn enable rapid process qualification of the TSW process and components produced by the process.

Primary U.S. Work Locations and Key Partners





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Completed Technology Project (2012 - 2013)

Organizations Performing Work	Role	Type	Location
Keystone Synergistic Enterprises, Inc.	Lead Organization	Industry	Port Saint Lucie, Florida
Marshall Space Flight Center(MSFC)	Supporting Organization	NASA Center	Huntsville, Alabama

Primary U.S. Work Locations	
Alabama	Florida
Mississippi	

Project Transitions

February 2012: Project Start

February 2013: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/140691)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Keystone Synergistic Enterprises, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

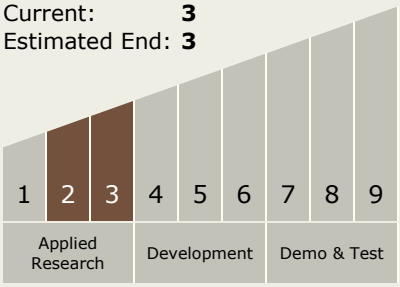
Carlos Torrez

Principal Investigator:

Bryant Walker

Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **3**



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Completed Technology Project (2012 - 2013)

Technology Areas

Primary:

- TX12 Materials, Structures, Mechanical Systems, and Manufacturing
  - TX12.4 Manufacturing
    - TX12.4.2 Intelligent Integrated Manufacturing

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System